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NAVY SPACE OPERATIONS IN THE 21st CENTURY: SAILING AMONG THE STARS

By

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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The proliferation of space technologies, systems and services is creating a threat to naval operations in theater. To counter these threats and take advantage of the emerging technology the Navy needs to understand what space capabilities are required. An analysis of the five enduring Navy roles as laid out in "Forward...From the Sea" shows where space threats and capabilities cross. This intersection provides a framework within the construct of USSPACECOM's Long Range Plan to examine Navy space requirements. The Navy as a provider to USSPACECOM and a user of many space services has unique capabilities that can be used to project power into space. The integration of space control capabilities and sea borne forward presence can provide an umbrella of security for friendly forces in a theater.

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INTRODUCTION

In the not too distance future, a regional Commander-in-Chief (CINC) may task an Aircraft Carrier Battle Group into a theater that does not have space superiority. Enemy satellites may be watching and listening to every move. Cruise missiles updating target locations from these satellites threaten all but the smallest ships. Ballistic missiles transiting through the lower bounds of space strike their targets with pin point accuracy, thus denying a safe area to plan and stage operations. Information technology, weapons of mass destruction, cruise and ballistic missile proliferation are creating deadly threats to classic naval operations and many of these threats will come from or through space.

The Navy is at a crossroads. In the past, the Navy relied on its own shipboard capabilities to carry out our nations will. In the future the Navy must rely on US Space Command (USSPACECOM) to provide space superiority, without it, the Navy's capital ships may stop being assets and immediately become liabilities to conducting theater operations.

The Commander-in-Chief of USSPACECOM (CINCSPACE) is responsible for all Department of Defense (DoD) space operations, but relies on the component commands and the individual services to furnish the tools to accomplish the mission.[1] Air Force Space Command (AFSPC) has been working many of these theater issues, but it is still a largely under developed area. The Navy with its forward presence and immediate access to the theater could provide CINCSPACE with capabilities that no other service has the ability to provide.

This paper will examine what the Navy should bring to the fight for CINCSPACE. The analysis will compare the effects of future space threats to the enduring roles of the Navy and identify potential space capabilities that should be investigated in more detail. It will also

suggest which of these capabilities should be developed in-house, as joint endeavors or outsourced altogether.

THE NAVY MISSION

The Department of the Navy's look into the future "Forward...From the Sea" describes the Navy as having five fundamental and enduring roles in support of the National Security Strategy.[2] These are:

- Projection Of Power From Sea To Land
- Sea Control And Maritime Supremacy
- Strategic Deterrence
- Strategic Sealift
- Forward Naval Presence.

The end of the cold war brought about changes within the Navy that shifted its focus from operations at sea to projecting power from the sea into the littorals and regions adjacent to the oceans.[3] Tomorrow, technology and evolving threats may once again shift the Navy's focus, this time to projecting power from the sea into space.

DESIRED END STATE

The Navy of the 21st century will need to ply the seas unobserved by the omnipresent eyes and ears in space. Sleek Navy ships crewed by space smart people will be the first ones in theater. Friendly forces will operate under an umbrella of security provided by the Navy's ability to project power into space. It will blind and deafen the prying eyes and ears of enemy satellites, destroy incoming missiles and strike back at enemy forces deep inland. The enemy will have no place to hide as our own satellites beam continuous knowledge-based information back to the right decision makers, the right shooters at the right time, through a space based network centric backbone.

The Navy's fundamental roles will not change in this future, but the threat to operations from space systems will change how it accomplishes those roles. The Navy of tomorrow will have to project power into space just as it projects power onto land today. The Navy is unique among the services, it is highly mobile and forward deployed, in addition, every capital ship brings with it a robust combat infrastructure. It must use these attributes and focus on the space capabilities that will deliver the most to CINCSPACE while at the same time ensuring the Navy mission.

NAVY SPACE OPERATIONS IN THE 21ST CENTURY

The 21st century is already here, it is being characterized by evolving threats, global politics and a constantly changing operating environment. As more countries migrate missions to space, the Navy will need to ensure that its enduring roles are supported by space systems. These new space systems should focus on high leverage capabilities and emerging space threats against theater level naval operations.

THREAT

The fall of the Berlin Wall brought about an end to the Cold War but also closed the book on many of the blue water navy missions. Without a peer competitor on the high seas the majority of future conflicts will not take place on the open ocean but in the confines of the littorals. This confined operating space will limit the maneuver warfare that the Navy of yesterday took for granted and has the potential to make naval operations even more dangerous.

The peace dividend that was so widely acclaimed brought with it the proliferation of technologies previously held only by the U.S. or the U.S.S.R. The failed states, civil unrest and internal conflict of the post Cold War period has created a world that is arguably more hostile than the measured antagonism of the Cold War. The increase in hostilities and proliferation of

technologies has armed many third world countries with advanced weapons. "Advanced technologies can make third class powers into first-class threats," stated Dick Cheney, Former Secretary of Defense.[4]

The future space threats to naval forces in theater will come from many directions. First, enemy surveillance satellites will be watching and listening to our every move, next will be the threat to friendly forces from incoming space transiting or space based weapons and finally the deliberate disruption of our information collected, transmitted and relayed through space. Each of these general threats will be examined below.

SURVEILLANCE SATELLITES

Timely surveillance is a key element that would complete the military capabilities of many nations. The days when only the US and the USSR had spy satellites is over. Multinational commercial companies are selling near real time one meter resolution imagery on the world wide web.[5] Space Imaging will sell five day old images for less then $300 per square mile and with perfect conditions can deliver a preliminary image in 30 minutes.[6] The commercial sensors that are being placed in space today can be used for targeting and battle damage assessment (BDA) by nations that do not have the capital to build their own space and satellite programs. It will still be difficult for an individual high resolution satellites to find Navy ships, but the combining of commercially available technologies and services with military systems and each other will change that.

In the early 1970's the Soviets combined the broad scanning capabilities of an electronics intelligence (ELINT) satellite with the imaging of an active radar ocean reconnaissance satellite (RORSAT) to detect, identify and target ships at sea. The information was then downlinked to

long range surface-to-surface missile platforms.[7] The commercial push for more and better imagery from space will make theater operations increasingly more difficult and dangerous.

SPACE BASED/TRANSITING WEAPONS

Theater ballistic and cruise missiles are becoming the weapons of choice for many third world countries. Adding the specter of nuclear, chemical or biological warheads to these missiles increases their military worth. North Korea recently tested a No Dong 3 missile that has the capability to reach Alaska or Hawaii.[8] Today they may not have the accuracy to hit the intended target but with a nuclear warhead that may not matter.

The Chinese have slowly and steadily increased the range and mobility of their missile fleet.[9] They have also been accused of stealing various technologies to increase the accuracy of these missiles.[10] The real danger from Chinese missiles will likely come from their sale to other countries. In addition, they have an on going space program that will have direct technology spin-offs to the missiles programs.[11]

There are currently no nations that have space based weapons that can strike ground targets but the technology exists today and it is only a matter of a nation's will or desperation before a system like this is fielded.

OFFENSIVE SPACE CONTROL

Identifying space control threats always brings some uncertainty, but a couple of threads of consistency have emerged. First the world saw how valuable space systems were during Desert Storm and second it is not likely that a future adversary will be as cooperative as Saddam Hussein. Several countries already have the capability to blind optical sensors on our satellites using ground based lasers.[12]

In the recent Kosovo operations, 80% of the satellite communications were carried by commercial satellites.[13] This has created a military dependency on a large undefended commercial infrastructure that could be targeted by our adversaries.[14]

It has been almost 20 years since the Soviet Union last tested a co-orbital anti-satellite, the Cosmos 1379.[15] There are no indications that they will build systems like this again but others nations are developing missiles that can destroy satellites in Low Earth Orbit (LEO).[16]

The most fearful threat to space systems is that of nuclear weapon detonated in LEO. The effects are speculative, but in technical terms it is generally agreed that it would make a big mess.[17] It is probable that all LEO satellites would be rendered unusable in a very short period of time and the effects on the GEO satellites are even less understood but are considered to be debilitating. The use of a LEO nuclear weapon might be considered a rational course of action for a nation that is not heavily dependent on space systems. It would level the playing field of a space dependent nation such as the U.S.

ANALYSIS OF NAVY ROLES

In 1998 Gen Estes CINCSPACE laid out his *"Long Range Plan; Implementing USSPACECOM Vision for 2020."* The vision defined the operational concepts; Control of Space, Global Engagement, Full Force Integration and Global Partnerships that CINCSPACE required to succeed.[18] Each of the operational concepts is defined by key objectives as shown in Figure 1. To support CINCSPACE, the capabilities developed by each of the supporting services need to link to the key objectives.

Control of Space	Global Engagement
The ability to assure access to space, freedom of operation with the space medium and an ability to deny others the use of space.	*The combination of global surveillance of the Earth, worldwide missile defense and the potential ability to apply force from space.*
Surveillance of Space	World Wide Surveillance
Assure Access	Missile Defense
Protect/Prevent	Force Application
Negate	
Full Force Integration	**Global Partnerships**
The seamless joining of space derived information and space forces with information and forces from the land, sea and air.	*Global partnerships augment the military's space capabilities by leveraging civil, commercial and international space systems.*
Organization	Military Core
Information	Commercial
People	International
Policy and Doctrine	Civil

Figure 1. USSPACECOM Operational Concepts[19]

To determine the space capabilities required by the Navy, an analysis must start with the Navy's five fundamental roles. The naval requirements for each role are determined first, then the space capabilities needed to support those requirements can be identified. Finally the space capabilities can be mapped to the key objectives within the USSPACECOM Operational Concepts construct. Each role will have to be performed under the defined possible threats. The examination will look for the space capabilities that will counter the threat or enable the mission to be accomplished.

To constrain the analysis, the space capabilities are limited to sea based Navy but broadly defined so as not to be technology specific. This eliminates the "Battlestar Galatica" answer of placing ships in space with unlimited armaments. The required naval and space capabilities will be described in the following paragraphs and the linkage to the space capabilities will be summarized in Table 1.

SEA CONTROL AND MARITIME SUPREMACY

Sea Control and Maritime Supremacy are the core of the Navy missions. By assuring access to the seas, freedom of operations and denying others the same, the Navy can fulfill the

remainder of its roles. The Navy must have a shared theater awareness to locate and negate other ships and threats within the theater that it will control. Theater missiles and satellites are the newest threats that will have to be countered in the 21st century.

To support this role the following space capabilities are required:

- Communication Relay
- Navigational Information
- Detect, Identify & Target Terrestrial/Air Objects
- Detect, Identify & Target Space Objects
- Negate Space Threat
- Theater Missile Defense

PROJECTION OF POWER FROM SEA TO LAND

Power projection is the Navy's offensive capability in the theater of operations. To effect the battle on land, the Navy must have control over the littorals and expand the theater awareness to locate and negate targets ashore. Missiles carrying WMD warheads will have to be negated before they start their terminal phase of flight to prevent the potentially deadly debris from falling on friendly forces.

To support this role the following space capabilities are required:

- Communication Relay
- Navigational Information
- Detect, Identify & Target Terrestrial Objects
- Detect, Identify & Target Missiles in Flight
- Missile Defense

STRATEGIC DETERRENCE

The Navy's ballistic missile fleet makes up the third leg of the US nuclear triad. To be a successful deterrent the fleet must be able to respond quickly to the National Command Authority without detection from enemy forces. In addition, without the bi-polar world of the

Cold War the missiles may have to be quickly retargeted, further driving the need for a robust communications system.

To support this role the following space capabilities are required:

- Communication Relay
- Detect, Identify & Target Terrestrial Objects

STRATEGIC SEALIFT

Transportation Command needs to know where a designated piece of cargo is at all times to ensure the effectiveness and efficiency of strategic sealift.

To support this role the following space capabilities are required:

- Communication Relay
- Navigational Information

FORWARD NAVAL PRESENCE

The mobility of the Navy give it the ability to go where they are needed quickly. Forward presence can be considered a pre-hostilities action, but once ships are in theater they must have a theater awareness to allow them to quickly respond if hostilities break out.

To support this role the following space capabilities are required:

- Communication Relay
- Navigational Information
- Detect, Identify & Target Terrestrial/Air Objects
- Detect, Identify & Target Space Objects

ROLE	Required Naval Capability	Required Space Capability	USSPACECOM Key Objectives
Sea Control and Maritime Supremacy	• Theater Awareness • Locate Other Ships/Threats • Negate Other Ships/Threats • Theater Missile Defense	• Communication Relay • Navigational Information • Detect, Identify & Target Terrestrial/Air Objects • Detect, Identify & Target Space Objects • Negate Space Threat • Theater Missile Defense	• Information • World Wide Surveillance • Surveillance of Space • Negate (Space Threats) • Missile Defense
Projection of Power From Sea to Land	• Effect the Battle on Land • Theater Awareness • Locate Terrestrial Targets • Negate Terrestrial Targets • Negate WMD Missiles	• Communication Relay • Navigational Information • Detect, Identify & Target Terrestrial Objects • Detect, Identify & Target Missiles in Flight • Missile Defense	• Information • World Wide Surveillance • Missile Defense
Strategic Deterrence	• Quick Nuclear Response • Undetected Locations Know When to Launch • Know What to Strike	• Communication Relay • Detect, Identify & Target Terrestrial Objects	• Information • World Wide Surveillance
Strategic Sealift	• Move Cargo • Know Where What Is	• Communication Relay • Navigational Information	• Information
Forward Naval Presence	• Go Where Needed • Pre Hostilities Theater Awareness	• Communication Relay • Navigational Information • Detect, Identify & Target Terrestrial/Air Objects • Detect, Identify & Target Space Objects	• Information • World Wide Surveillance • Surveillance of Space

Table 1. Summarized Requirements

SPACE CAPABILITIES TO SUPPORT ROLES

The requirements summarized in Table 1 show some overlap in space capabilities for

each of the roles. These overlaps indicate areas that have potential for high payoff in supporting

the Navy and USSPACECOM. The overlaps will be looked at in more detail to determine if the

capability can be provided from a sea based platform or used by it.

INFORMATION (CONNECTIVITY)

The Navy of the 21st century is already information dependent. It must currently depend

on commercial satellites to carry the huge quantities of information. Roughly 80% of the traffic

is now carried by commercial satellites.[20] Commercial carriers provide this service for a fee and

the Navy may not be the preferred customer. The Navy and DoD as a whole need to be able to

transmit large volumes of information in a secure environment at a moments notice. Commercial

satellites have become critical nodes in the military communications network. Their loss would greatly effect the synchronization of theater operations, to this end the Navy and DoD as a whole need to reassess the survivability of this commercial network. In addition, with the greatly expanding land based cellular and fiber optic systems[21] commercial companies may migrate away from satellite relayed communications if the profit margin goes away. This is an area where the Navy and DoD need to continually monitor the communications environment and possible reinvest in military only systems.

INFORMATION (NAVIGATION)

Navigational information is currently provided by AFSPC's NAVSTAR Global Positioning System (GPS), a 24 satellite constellation that continuously transmits data that can be received and translated into a location. This space capability is used by the Navy, DoD and the rest of the world. The Navy does not need to duplicate this capability but does need to understand its uses and limitations.

WORLD WIDE SURVEILLANCE

Today's surveillance systems are excellent at providing detailed information of known objects in a fixed location. Unfortunately, they are also very labor intensive, requiring a human analyst to examine all information before it is forward to the fleet or field. These limitations prevent a commander from using them to identify ship traffic along a coastal region or moving tanks ashore. The capability to provide continuous real time observation of objects on or near the earth's surface can provide the commander with the situational awareness needed in a high threat theater.

In the late 1970's, the Navy was working on a space based active sensor radar, the Clipper Bow project[22]. After an interservice struggle with the Air Force, it was canceled in 1979.

Today the Air Force, DARPA and the NRO are investigating a capability to detect and track

moving ground targets in the Discoverer II project.[23] This is only one of many World Wide

Surveillance capabilities that will become invaluable to the Navy as it continues to move into the

littoral and project power ashore. The Navy needs to ensure that World Wide Surveillance

capabilities are an integrated extension of ship board sensors.

NEGATION (SPACE THREATS)

Today, no capability exists to prevent someone from locating and targeting our forces

from space. The 9 July 1999 Department of Defense Space Policy states that "Space activities

shall contribute to the achievement of U.S. national security objectives by countering, if

necessary, space systems and services used for hostile purposes.[24]" This new policy restates the

requirement for the military to be able to execute combat operations in space.

Care must be taken in defining what effects need to be created when countering hostile

space systems. Physical destruction of a satellite can result in a debris field that leaves an orbit

unusable for future operations. In addition, many satellites especially commercial satellites,

maybe used by both sides during a conflict. Its negation would deprive both sides of a valuable

resource.

Negation of space systems can be thought of in two ways, permanent and temporary.

These effects can be accomplished through power projection and passive protection. The Navy's

ability to project power, either as mass or energy at a space system (including the ground station)

would give it the capability to better control the events within a theater. The second means of

negation is though passive protection. This involves the design of ships and operating

procedures that negate the capabilities of an enemies space assets.

Power Projection

The Navy may needs to negate enemy space based systems to support theater operations in the littorals. Advances in lasers and radio frequency jamming could be integrated into ship based platforms. The Navy has proposed electric propulsion for future ships,[25] this opens up new possibilities for high energy weapon systems on board ships that would quickly begin operations in theater. This type of power projection can be tailored to produce permanent or temporary effects without creating orbital debris.

Passive Protection

The large conventional gray hulls of The Navy have a lot of room for continued improvement in passive protection. Stealth technologies such as those incorporated into the Sea Shadow reduces the ability of land and space based radar to detect and identify the ship.[26] Operational procedures such as emissions control (EMCON) need to be reevaluated continually as the ELINT satellites capabilities continue to improve.

SURVEILLANCE OF SPACE

In order to negate space based systems they must be able to be detected, tracked and targeted. Current systems survey space objects from fixed land based sites and log the information into a large data base. These systems provide a capability to predict when an object will be in theater but they do not track it, any on-orbit maneuvering capabilities would render a satellite practically invisible.

The Navy's sea based operations can provide platforms for space surveillance within the theater. The SPY-1 radar on the Aegis class ships[27] is an example of the kind of system that could be developed to track space objects within a theater of operations.

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MISSILE DEFENSE

Missile defense, specifically theater level defense is a growth industry today. All the services are currently developing capabilities for a multi-tiered defense to counter this threat. A ship borne missile defense systems such as the Navy Area and Theater Defense have the advantages of deploying with the ship and do not have to be set up once in theater. It can provide an instant umbrella of security as soon as the ship arrives in theater.

THE WAY AHEAD

The USSPACECOM *Long Range Plan* lays out a good roadmap for the future. It explains what needs to be done and when, but not who. The Navy's unique attributes of sea based platforms and forward presence lend themselves to exploiting certain capabilities that have high pay off for the Navy and support CINCSPACE in the process. To complete the analysis, care must be used to prevent engineering the solution. The use of the following criteria will help identify areas that should be further investigated. Those criteria are:

- Does the capability directly support theater operations in the littoral regions of the world
- Does the capability lend itself to ship-borne operations

IN HOUSE CAPABILITIES TO DEVELOP

The Navy is not responsible for providing all space capabilities required in theater, but it can provide capabilities best suited for its enduring roles. These capabilities would directly support the Navy in the operation theater where there is a high space threat. Based on the selection criteria the Navy should focus on the following capabilities:

- Theater Space Surveillance
- Negate, Space Systems in Theater (Power Projection)
- Negate (Passive Protection)

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JOINT CAPABILITIES TO DEVELOP

Capabilities that the Navy is or would be a major user and benefactor need to be developed in a Joint environment. This would allow each of the services to ensure that their requirements are being met and spread the development cost out among the users.

- Information (Connectivity)
- Information (Navigation)
- World Wide Surveillance
- Missile Defense

WHAT SHOULD THE NAVY OUTSOURCE

The last category contains capabilities the Navy should outsource to other services or buy commercially. The space capabilities that do not directly support the theater mission or will already be provided should be outsourced. Care must be taken in any choice for outsourcing. The caveat of 'buyer beware' holds true, especially when purchasing commercial systems or services. Navigation is one of the capabilities that the Navy should continue to outsource, others include the capabilities that CINCSPACE is requiring in the Long Range Plan such as spacelift and space range modernization.

- Surveillance of Space (Fixed Global Sites)
- Information (Navigation)
- Negate (Global Space Threats)

CONCLUSIONS

The threat to naval operations from space based systems is real and increasing. The global political environment is forcing operations to move into the confines of hostile littoral regions. Third world adversaries with a credit card now have access to space derived information and intelligence that just a few years ago was the domain of the super powers.

The Navy with its mobility and presence is usually the first ones in the theater to support the CINC. They will be called upon to accomplish the seemingly impossible. But they can't do it all. What they can do is leverage their inherent strengths with key space capabilities that give CINCSPACE the tools and the access to accomplish the space mission in theater for the region CINC.

The Navy should focus its space capabilities on theater operations. It should develop those capabilities in house, see Table 2, while actively supporting joint development of more global capabilities. Finally the Navy should outsource those capabilities that do not directly support the five fundamental and enduring roles of the U.S. Navy or that are already provided.

Required Navy Capability	Navy	Joint	Outsource
Surveillance of Space	Theater		Global
World Wide Surveillance		X	
Information (Connectivity)		X	
Information (Navigation)			X
Negate (Power Projection)	Theater		Global
Negate (Passive)	X		
Missile Defense		X	

Table 2 Capability Ownership

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